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CNA Information Products for the Information Age

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Summary

This paper summarizes the insights of a long-term, CNA self-initiated project. This project undertook to explore and experiment with applying interactive technologies and techniques to communicating CNA's research to its Navy and Marine Corps sponsors. Our approach was an applied one: we created interactive electronic media and war-games derived from, or in support of, other Navy- and Marine Corps-sponsored CNA studies. In the process, we developed insights and perspectives on the role interactive media might play in CNA's future support for the Department of the Navy (DoN) and other clients, particularly those in the Department of Defense (DoD).

CNA's mission is information

As DoN's federally funded research and development center (FFRDC), CNA provides research and analysis to support military and other governmental decision-makers. Research and analysis requires collecting, assessing, manipulating, producing, and communicating information. Our fundamental research processes can be described in terms of information.

- We capture current information based on the close relationships we have developed with the Navy and Marine Corps and other research sponsors.
- We create new information and ideas, using the information we capture as a foundation, through our research and analysis.
- We communicate the results of our efforts to our clients and other stakeholders, typically through printed publications and briefings delivered in person.

CNA's working environment and relationship with the Navy and Marine Corps is a traditional one, based on over 50 years of experience. Because our mission is information, the "information

revolution” is transforming that environment and relationship at the most fundamental level. How can CNA and DoN begin to understand how this revolution can, will, and must affect that environment and relationship in the future? And what we can do about it?

The information revolution is upon us

At least, that’s what all the media, even the old media, keep telling us. Indeed, many believe that this revolution may give birth to the most comprehensive changes the world has seen in the processes and techniques of human communications since the introduction of the printing press in the 15th century.

The piston driving the engine of revolution is the small (and growing ever smaller) computer. Its fuel is the variety of electronic media that feed the computer and provide us more, new, or better sources of information. In most cases, the media themselves are not new: text, graphics, animation, video, audio, all have been around for a long time. Even the combination of media into what we like to call multimedia is not new. What is new is:

- The simultaneous access to all of these media available through a single device (the computer)
- The ease with which we can create and manipulate these media, even in our own homes
- The ability to move beyond the strictly linear nature of most media to a more flexible mode of access and connection through hypertext or other forms of interactivity.

But the heart of the information revolution lies not in electronic media nor in multimedia nor in interactivity. It lies instead in the combination of interactivity and interconnectedness. If the computer is the piston of this revolution, the engine itself is the computer network. Indeed, it is the network in all its forms that powers this revolution and defines its essential character as the first true “many-to-many” communications channel.

As we speak with one another through this new channel, we are beginning to discover that an old concept gives us a new language

which can help us address some of our new issues. From childhood diversions, to adult amusements, to synthetic worlds, the power of gaming—harnessed to the new tools and channels of the information revolution—offers us a powerful new way to share problems and solutions across the many-to-many communications channels enabled by the networking of computers.

From revolution to community

Over the course of our exploration and experimentation with these new ideas, these new tools, and these new channels, we have learned a lot. Mostly, we have learned how little we really know about the future directions the information revolution may take. It is difficult to understand that future, risky to predict it, and even more challenging to invent it. But we have to do our best at all of those tasks, because being prepared for that future, and helping to shape it as it comes, is not an option. It is a responsibility.

To that end, we see three primary directions CNA can pursue, with the forbearance, support, and active partnership of DoN.

- Continue to explore the new electronic tools and channels, and the new language of gaming as they evolve with the information revolution. We need to understand where and how to apply them, and how to create and use them.
- Continue to educate and train CNA researchers and DoN operators about how to integrate the new tools, channels, and language into our traditional processes and practices. We need to expand and enhance CNA's support to DoN decision-makers.
- Engage DoN—and when possible and necessary, DoD and other sponsors—in jointly developing an interconnected and interactive community of analysts and operators. We need to capture, create, and communicate information in ways and at speeds we can only barely imagine today.

At the conclusion of the paper we recommend specific projects or efforts to implement these broad directions.

Capture, create, communicate

One of CNA's principal missions is to help Navy, Marine Corps, and other DoD leaders make better decisions. We do this by providing decision-makers with the results of our analysis and with recommendations we derive from those results.

CNA's current mode of operation is based on our long-established traditions and experience with the Navy and Marine Corps. The heart of those traditions is an intimate understanding of the real issues our analysis must address. There are three primary ways that we do this.

First, some of our analysts work as integral parts of field commands or other organizations. The analysts share operating conditions and concerns directly with the commands. They do analysis in direct support of the commands. They also provide liaison to CNA's Washington-based staff, helping the command make contact with analysts whose specific expertise can be of use. In this role, the field analysts also help keep CNA's Washington-based staff up to date on what is happening in other commands, and provide us an inside source of authoritative information about the command and its issues.

Second, when we are not partners in the day-to-day operations of the command sponsoring a study, we try to get as much first-hand experience of their operations as possible. Analysts conduct personal interviews and establish other direct communication with the sponsors and other sources of information. Such involvement allows us to capture quantitative and qualitative information—not only “data” but also impressions and intangibles like a better understanding of specialized language and command-specific attitudes. Such information can make the difference between a study that contributes little to the real issues and one whose recommendations are informed, helpful, and implemented.

Third, CNA's trusted relationship and special status as an FFRDC gives us ready access to a wide range of unique information sources. These include the Navy and Marine Corps staffs, other DC-based staffs and organizations, the joint community, and restricted documentary resources. Some of these sources are privileged documents seldom shared outside the direct chain of command of our sponsors or other commands. This sort of access gives us a solid foundation of information on which to build our analysis.

CNA's systems, processes, and traditions for doing analysis in support of the Navy and Marine Corps evolved in an era when the key data formats were things like naval messages, paper deck logs, and analog tapes. The flow of data was confined largely to hierarchical channels and formal processes. Today, the key data formats are often Power Point briefings, peer-to-peer e-mail, and large digital data files (of things such as imagery or record tapes of the Aegis radar system). Much of the vital operational data has become ephemeral, not archival. If we do not capture it in near-real time, it may be lost or irretrievable.

CNA's ability to capture our sponsor's information in such intimate and timely detail is fundamental to our ability to create new ideas and new information to support the sponsor's decisions. The processes of actually doing analysis is complex, multifaceted, and frequently individualistic. Rather than attempt to describe what we do in detail, let's focus for a moment on characterizing the basic nature of our work.

That nature is highly creative. Analysis can be described as the process of creating new ideas and new information from old. It is based on scientific principles. But it is not the science of the high-school chem lab. It is real science, messy science, creative science. Whether based on physics, mathematics, economics, or political science, we can characterize the best CNA research and analysis as creating order—or at least insight—out of chaos.

CNA's senior Vice President for Research has best articulated the goals and processes of CNA analysis in his statement of research standards. Let me paraphrase that statement.

CNA strives to do research and analysis that is sound, objective, thorough, timely, and reproducible. We strive to communicate our results clearly. And we make a special effort to ensure that our work has a real impact on our sponsors.

- By *sound*, we mean that our information, our methods, and our models are adequate to support the results we obtain from them; that our work reflects an accurate understanding of the systems, processes, or procedures at issue; and that our arguments are relevant, logical, and based on fact.
- By *objective*, we mean that we do not allow our attitudes, analytical approach, results, or interpretations to be influenced by what we think our sponsor would like to hear, or by our own biases and preconceptions; we approach every problem with an open mind and we go where the facts lead us; we believe that the truth, to the best of our ability to determine it, is in the best long-term interest of our sponsors.
- By *thorough*, we mean that we consider every relevant aspect of a problem; we approach our analysis like the best of scientists—we are continuously testing, refining, and attempting to refute our own hypotheses based on the best information and data we can collect.
- By *timely*, we mean that we complete our analysis in time for the decision-maker to use its results to inform the decision at issue; when there is a conflict between timeliness and thoroughness, we are forthright in revealing all limits to the scope and depth of our research dictated by the deadline for obtaining useful results.
- By *reproducible*, we mean that we describe our work in a way that would allow a qualified professional to understand exactly how we obtained our results; reproducibility of this form requires some form of documentation, whether formal or informal, paper or electronic; peer review is a good way to test for reproducibility, but both documentation and peer review are a means to the greater end of ensuring that our analysis is reproducible and available for others to replicate should they wish.

But simply *doing* good analysis, as defined above, is not enough. CNA's mission is an applied one. Our ability to communicate clearly is frequently at least as important as our ability to think clearly. Both are essential if our analysis is to have intellectual merit and achieve operational impact. And by *impact*, we mean that our analysis affects a sponsor's decision on an important matter in a significant way.

Typically, we communicate the key results of our analysis in terms of findings and recommendations. We brief these results to the sponsors of the research and, if they agree, to other interested commands. Details of assumptions, methodology, and the analytical process and results may be documented further in formal research papers distributed to a selected audience and made available to other interested and properly authorized researchers or organizations.

Thus, CNA's working environment and relationship with the Navy and Marine Corps is based on tradition but evolves to meet the needs of the times and our sponsors. CNA's goal is to produce analysis of the highest quality—analysis that, by our own definition exhibits the following characteristics:

- It becomes manifest when dealing with unstructured problems of significant breadth and complexity.
- It is grounded in a thorough understanding of the issue, its context, and the relevant technical disciplines and literature.
- It addresses the right questions and it answers those questions with imagination, insight, and innovative application of sound analytical techniques.
- It communicates its methods and its results clearly, completely, and convincingly.
- It usually leads to recommendations that the sponsor can act upon.

CNA's mission is information—capturing it, creating it, and communicating it. As today's "information age" changes this fundamental element of our mission, how do we see CNA's environment evolving?

Information, interactivity, interconnectedness

We're awash in information. It's everywhere. All the time. In every conceivable form. Yesterday, I was driving back to CNA with a couple of my colleagues. We had just finished extended discussions with some of the instructors at the Navy-Marine Corps Intelligence Training Center (NMITC) near Virginia Beach. NMITC is responsible for training those to whom collecting, assessing, and disseminating information can be a life and death mission on the battlefield. Ironically, we were briefing the NMITC staff about a project exploring how to use commercial computer wargames in their training curriculum, a general subject we will discuss later in this paper. But that's not the story I want to tell you about information.

Information

We stopped at a gas station in the pouring rain. While I ran my credit card through the gas-pump's card reader to turn it on, and stood in the rain pumping the gas (from a very slow pump, I might add), my friends went inside to get some sodas and juice. They returned a bit more irritated than when they had left. What had seemed like a simple task of selecting their drinks and simply handing over the money had turned into a slightly more complex one. It seems that the store had one of those machines to read universal product codes, and so the clerk had to take their sodas and scan them into the system before ringing up their purchase and relieving them of their cash. I joked that the system was probably one of the latest integrated logistics systems which automatically tracks inventory, orders restock, and conducts market research on what other products they bought when they bought the drinks (in this case, cookies).

Ten years ago, even five years ago, that remark might have been little more than a joke. Today, it seems a little less. In truth, my comment may well have been accurate. On the other hand, so may have been Alan's reply: "And they still don't order enough Diet Coke!"

If CNA is going to help our sponsors “order enough Diet Coke,” we have to present the information our analysis provides them in ways they can understand, remember, and act upon. Improving our ability to accomplish this goal became one of this project’s primary tasks. Understanding how to package that information in products that would be useful to our sponsors, and how to exploit the channels available to us to get those products to our sponsors, became our first order of business.

There’s a saying popular among some of the more experienced CNA analysts that, “We don’t build toasters.” We tend to trot this saying out in response to misguided attempts to compare the way we work with current trends in “business.” We may not be in the business of manufacturing kitchen appliances, or bicycles, or any other industrial products. But we are in the business of producing a product, and that product is information. Nor are we alone in this “industry.” As long ago as 1996, researchers in this field argued that the “information products industry, broadly defined to include products based on data, information, and knowledge, is intensely dynamic in terms of growth and the pace of new product introduction.”¹

Like many other studies-and-analysis organizations, as late as the mid-1990s, CNA still produced only two basic types of information products: research papers (in various guises) and acetate briefing slides (usually published in paper form as well). Both these products were static information displays. They were manufactured using black ink on white paper (or clear acetate)—with very rare appearances of color briefing slides but almost never color ink on paper. Even photographs were few, though line drawings and data graphics spiced up some work. The most advanced technology in CNA’s research products was the staple.

To get these two products into the hands—and heads—of our sponsors, we relied on two distribution channels. We could mail or hand deliver a paper for you to read (including a paper copy of acetate briefing slides). Or we could send an analyst to give you a live presentation of the information.

1. Marc H. Myer and Michael H. Zack, “The Design and Development of Information Products,” *Sloan Management Review*, Spring 1996, 43-59.

CNA research papers could be—and sometimes were—widely distributed, but usually the distribution list for any paper was fairly short. Often we restricted distribution to DoN commands and agencies. If the sponsor wished or CNA felt it was important, we distributed papers to potentially interested organizations in the wider defense community. Even so, because of the fixed nature of paper products, their useful life tended to be short. Eventually, the original recipient of a paper would turn to new issues or change jobs, and the paper would become lost, destroyed, or simply forgotten.

Live briefings are, of course, even more ephemeral than research papers. Once given, little trace of them remains except in the memories of the audience and presenter. In fact, it is easy to consider a live briefing as not only a distribution channel, but also an information product in its own right—a performance, as distinct from its slides, notes, or script as a finished movie is distinct from its screenplay.

Indeed, the presence of a live briefer adds new media elements missing from static products: sound, movement, and even interactivity. Conventional wisdom among CNA project directors is that the briefings are what the sponsors value most. The information content of a briefing is more readily adapted to the audience because the briefer can adapt the presentation and adjust discussions to specific comments and questions. Papers are tangible, archival documentation; briefings are the principal means of communicating the important information directly to the sponsor.

New electronic multimedia products provide many of the benefits of a live presenter without requiring us to pack a human analyst-briefer in every box. Multimedia also lets us integrate directly into a single product the kinds of non-documentary information too awkward to include before. Now a single product, embodied in an electronic computer file, can include not only text and line art, but also audio, video, and animation. We can use dynamic media to demonstrate dynamic processes.

Of course, none of these media are new in themselves. When we were in grade school during the 1950s and 1960s, we used to watch filmstrips in class. These film strips came complete with a sound track on long-playing phonograph records. This was an early form of

multimedia. What is really new and potentially revolutionary today is our easy access to a wide range of media through a single device—the desktop (or laptop) computer. Even more important, the computer is also a one-stop shop for creating and integrating the different media into a single information product.

The personal computer helps our customers tailor the way they view our products so that our information can be most useful to them when they need it. What's more, we can design our information products to give our customers a new ability to interact directly with the information. They can let us guide them through the information just as we did before, or they can explore the information for themselves. We can give them something of the sort of interactivity they could once get only during a stand-up briefing.

Myer and Zack use a particularly good metaphor to describe the options modern producers of information products can make available. "It is similar to baking a cake: some customers want to start from scratch (access to raw data), others prefer a cake mix (access to preprocessed cells or units of information), while others choose to purchase a ready-made cake from a bakery (access to finished reports and analyses)."²

Interactivity

To take full advantage of the flexibility new technology gives us to provide sponsors a wide range of new information products, we turn to one of our key tools—the concept of interactivity.

Interactivity is the user's ability to dynamically select, manipulate, integrate, and format the information to suit particular and changing needs. . . . Providing users direct control over the packaging and content of the product itself can be a highly desirable product feature. As information products become more dynamic (e.g., interactive TV, magazines, and information services), mechanisms to allow individualized, useful, and relevant feedback to the information supplier will produce even greater product variation.³

2. Myer and Zack, 1996, p. 49.

3. Myer and Zack, 1996, p. 49.

Interactivity couples exploration with collaboration. An interactive information product invites users to uncover the information in their own way, not necessarily the way the provider of the information chooses to reveal it. This distinction is an important one.

Educators and psychologists discuss several different “styles” people use to acquire and process information. Some people

tend to focus on facts, data, and algorithms; others are more comfortable with theories and mathematical models. Some respond strongly to visual forms of information, like pictures, diagrams, and schematics; others get more from verbal forms—written and spoken explanations. Some prefer to learn actively and interactively; others function more introspectively and individually.⁴

The key point for producers of information products is that any approach that consistently ignores a user’s preferred style of learning is likely to have relatively poor effectiveness. This is especially the case when the product emphasizes instruction over study.

Researchers in the cognitive sciences have long distinguished between the concepts of study and instruction.⁵ In study, the learner is active, exploring and developing new knowledge by pushing and pulling on old knowledge, questioning and probing, playing and experimenting. Instruction gives the learner a passive role—the instructor chooses the knowledge to impart, the means of providing it, the pace of the instruction, and the mode of assessing the learner’s progress.

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4. Richard M. Felder, “Matters of Style,” *ASEE Prism*, 6 (4), December, 1996, pp. 18-23. Available on-line at <http://www.umich.edu/~crltmich/>.
 5. See, for example, Robert McClintock, “Toward a place for study in a world of instruction,” *Teacher’s College Record*, 73, 1971, 161-205. Discussed in Robert Glaser and Gail P. Baxter, *Assessing Active Knowledge*, CSE Technical Report 516, Center for the Study of Evaluation, National Center for Research on Evaluation, Standards, and Student Testing, University of California, Los Angeles, January 2000.

Perhaps not surprisingly, CNA's typical style of presenting information to its sponsors has closely followed academic practice in scientific and engineering fields. "For the past few decades, most engineering instruction has been heavily biased toward intuitive, verbal, deductive, reflective, and sequential learners. However, relatively few engineering students [or CNA sponsors] fall into all five of these categories."⁶

CNA's standard techniques of presenting the results of its research also derive largely from the instructional—rather than the study—model that so dominates the educational system. Again not surprisingly, CNA's earliest uses of interactivity, a natural tool for facilitating exploration and thus study (in these terms), focused on enhancing the ability of the "instructor" (the briefer or author of a paper) to control and direct the flow of information to the learner (the sponsor).

Acetate briefings typically included backup slides to provide additional information in response to questions from the audience or the briefer's perception of the need to go into more detail on a subject. It was a natural extension of this idea to include links in an electronic briefing to allow the briefer to jump to similar material. The increased ease of use and flexibility of the electronic presentation tool also allowed briefers to use more elaborate branching strategies to tailor a briefing in real time to the specific directions an audience seemed to be taking.

But applying these fundamental interactive techniques to a stand-alone product, one delivered to sponsors for them to use themselves, proves a bit more difficult. For one thing, the analyst must give up control over the way the "learner" accesses the information. It is far easier to provide a large collection of information than it is to structure that information to help the user of the information explore it effectively. Not only do you have to format the information in an accessible way, but you also have to provide some basic tools, like a reasonable table of contents, index, and electronic search capability.

6. Felder, 1996.

Delivering such stand-alone information products is like trying to collaborate with people you don't know by trying to anticipate what they might think about and what questions they might ask, so that you can try to prepare answers to all of them ahead of time. Inevitably, you won't be able to anticipate all the directions they may want to explore.

What's worse, the stand-alone product may let users interact with the information you give them, but it doesn't let you interact with the users in the process of their exploration. Your information, and your perspective on it, can affect them, but their own information and perspectives can't affect you. The interactivity is uni-directional and mechanical; it is limited and impersonal. It allows the users to explore a static, closed, finished information product. It does not involve them, and you, in an active, open, evolving process for creating new ideas and new information.

In a paper presented at the Massachusetts Institute of Technology, Luis Arata argues that interactivity in our context involves "active interrelations between players and mediums." That interactivity "in its most general form is a mode of creation, a way of being, a perspective."⁷

Arata's attitude is consistent with our own experience during this project. In addition to its value for helping us communicate our research results more effectively, we have seen that interactivity creates a new potential. We can use interactive tools and processes during the creative, research phase of a project. Working interactively can help us capture not only our progress along the main lines of analysis, but also our occasional diversions to related topics or concepts. One project may abandon a line of inquiry as unfruitful for its purposes—a later project may pick it up again as the key to new ideas and insights in a new situation. But only if we can keep these ideas alive, not bury them once the original project finishes its work.

7. Luis O. Arata, *Reflections about Interactivity*, presented at the Media in Transition Conference, Massachusetts Institute of Technology, on October 8, 1999. Posted at http://media-in-transition.mit.edu/articles/index_arata.html on 19 December 1999.

Historically, CNA's emphasis on multidisciplinary research teams envisions close interaction among team members during the course of a project. We also expect the researchers to maintain frequent and open communications channels with their sponsors, other CNA analysts, and outside experts during the course of the analysis. But we have tended to see those interactions as episodic and specific. We initiate the communications to discuss specific topics on specific occasions—data-gathering expeditions, interim progress reports, brainstorming seminars. In the process of this interaction and collaboration, we most often emphasize agreement. Our goal is to define, in a sense, the truth. The whole truth. And nothing but the truth. We recognize that sometimes this is not possible, but it remains at the very least a subconscious goal.

Because of this focus on the goal, our interest in the path to the goal often focuses on the final, direct route, ignoring the false turns and dead ends we may have taken along the way. After all, the sponsors aren't interested in that, at least not usually. So why bother documenting what didn't work when it's enough trouble documenting what did?

There are other perspectives about the value inherent in the process of analysis and the interactive way of pursuing it. Luis Arata articulates four key elements of what he calls the interactive perspective. "An interactive approach favors the use of multiple points of view which can coexist even if they appear mutually exclusive; it celebrates the creative value of play; it is a catalyst for emergence; and it tends to be ultimately pragmatic."⁸ Here we will concentrate on two of these aspects, multiple points of view and emergence.

CNA's analyses can sometimes provide hard answers to specific questions—especially when dealing with tangible, operational, or technical issues. Through analysis of software code implementing engagement protocols, and of the hardware comprising radar and missile systems, we can produce accurate and reliable calculations of the maximum number of surface-to-air missiles an Aegis cruiser can fire against an incoming threat aircraft under specific environmental conditions.

8. Luis O. Arata, 1999.

Other types of CNA analyses are less rigorous in the questions they address and the answers they produce. Is there a better way to organize the Navy's Chaplain Corps? And what does better mean? To whom?

In such cases, especially, ongoing interactivity among analysts, operators, and other interested parties can open the door for interactions among different and even mutually exclusive points of view. All the participants in such an interactive forum can share directly in the analytical process. This process creates new ideas and new information "organically" through a process more akin to gardening than sculpture.

As Arata describes, the French mathematician Henri Poincaré offers us an interesting illustration of some of these ideas. Poincaré saw truth in one sense as an object we strive to attain. Once we reach it, all that is left for us to do is to admire it, much as one would a Rodin sculpture on a pedestal. Yet he seldom saw such truth in things themselves, but more often in the relations among them—that even "failed theories left a valuable trace even as they vanished, and that trace had the scent of truth."⁹

We often see such effects in analysis. In one study, we take an approach only to discard it as unproductive. Yet, if we don't forget it, that same approach turns out to be a useful one next time. The proverb says, with some justification, that the "bad penny keeps turning up." But we also believe that in analysis a good idea is never really dead. It is only submerged in the stew of ideas waiting for something to stir it to the surface anew.

This emergence of new ideas from old through the processes of interactivity is the second key property we want to touch on here. Once again, we turn to Arata.

An emergent phenomenon cannot be predicted. Nor can it be entirely explained away a posteriori. Emergent phenomena are above all those which cannot be predicted by the behavior of its constituent parts. They happen as if on their

9. Arata, 1999.

own. Here we see the crucial role of interactivity. Only through the play or jiggling of interactivity is the stage set for emergent surprises.

In the process of capturing such emergent information and of creating new ideas, new information, CNA analysts frequently stand at the interface of science and art. Despite at least fifty years of attempts to pin down what we do—call it operations research or systems analysis or whatever you wish—as a “real” science, the element of art remains strong. It is a difficult spot for most of us to be in. We are mostly scientifically trained, and most of our sponsors are scientifically oriented and attuned. Again, Arata says it better than we can.

Science has traditionally dealt with repetitive phenomena, whereas the arts have favored special events charming by their inspiring uniqueness. In the realm of emergence we begin to look into events which are neither regular nor unique. They are surprises which can be managed to happen [sic] but never coerced into predictable repetitions. What I suggest is that an interactive perspective helps us map more effectively this new frontier opening between chaos and total order.

In this post-Cold War world, humanitarian operations like those in Somalia, and military coercion operations like those in Iraq and Kosovo, may well fit into this frontier between chaos and order. If so, we may be able to learn from them the lessons we will need to deal more wisely with similar situations in the future.

We can use interactive tools and processes as important means to help us explore emergent phenomena, by building a collaborative community of analysts and operators. In doing so, we’re going to have to rethink our old views of information products and channels. Interactivity can empower us to move beyond data collectors and interviews. Beyond study team meetings and brainstorming sessions. Beyond research papers and briefings. Interactivity can help us merge these processes into one another.

To bring that potential to fruition, however, we need one more piece of the puzzle, one more instrumentality. And that missing link turns out after all to be the engine powering this “Information Age” we are living in: the networked computer.

Interconnectedness

The computer is a great tool. It lets the consumer of information access a variety of media using a single device. It helps the producer of information package it in the best media to communicate effectively, and integrate those media in a single product—again using a single device. It makes possible new, and in some ways better, information products. But if everyone's individual computers remained separate, isolated from others, we would not be speaking today of an information revolution. In that case, despite its individual power and flexibility, the computer would be little more than an evolutionary development of the printing press.

The real information revolution is driven not so much by the new products, but by the new distribution channel—by the network linking my computer to your computer, down the hall, across town, around the world. Or perhaps more accurately, linking me to you, my colleagues, friends, and as-yet-unmet associates with whom I can now share problems, interests, and ideas. It is not the sharing that's new, of course, but the speed with which it can take place across such vast distances. Even more, it's the many-to-many communication capability the networked computer makes available to us that is revolutionizing the way we capture, create, and communicate information.

A paper by James A. Dewar of the RAND Corporation presents a powerful and persuasive discussion of this aspect of computer networks.¹⁰ Dewar argues for the potential networked computers may have to revolutionize society as a whole by revolutionizing the way we deal with information. He compares its effects with those of the printing press. "The printing press didn't create the book, it changed or redefined it."

Manuscript technology could produce very few copies of very few books. As a result, the books and the information they contained were

10. James A. Dewar, *The Information Age and the Printing Press: Looking Backward to See Ahead*, RAND Paper P-8014, 1998. (Available on-line at <http://www.rand.org/publications/P/P8014/P8014.pdf>).

available to very few persons, typically scholars or the rich. Preserving that information for current use and future generations to build upon was a chancy proposition.

The printed book changed that. More copies of more books in the hands of more people helped preserve hard-won information. It also helped improve the quality of the available information. As more readers read, they found more errors—sometimes in content and sometimes in presentation (the birth of type leading quickly to the birth of the “typo”)—and more publishers began to issue updated, corrected editions. This “feedback reversed the slow degradation of recorded thought and ushered in the era of accumulation of thought upon which the Scientific Revolution was built.”¹¹

Indeed, the community of scientists that grew from those early seeds played a crucial role in today’s new information revolution. The web browser and html (hypertext markup language) protocol, which are the foundation for the world-wide web and much of our ability to use computer networks, were invented by physicists at CERN (the European Center for Nuclear Research).

These new tools exploded across the world because conventional, document-based methods of disseminating information were simply too slow and too static to keep up with the pace of discovery in particle physics. Nor could they adequately support the requirements for global collaboration the research demanded.

It has perhaps always been the case that scientific findings are already outdated by the time they can be published in a book or journal article. But when the pace of innovation and the sheer volume and complexity of the information that must be disseminated reaches a critical level, there is a fundamental transformation in the needs and expectations of the research community. You can’t wait for the quarterly journal or weekly newsletter. You hit the web site to see what’s new today. You depend on the on-line newsgroup to answer questions and to keep in touch with collaborators and sponsors because sending snail mail and playing telephone tag are simply too slow and frustrating to work any longer.

11. Dewar, 1998.

Even today, much of the information CNA's research and analysis provides to the Navy and Marine Corps suffers from the problems associated with manuscript, or "scribal," technology. Though we print our papers using a descendant of the printing press, we disseminate them in numbers and through distribution channels closer to those used during scribal times. Too often our papers can become buried in the bottom of someone's safe or filed "in the circular file" when the original recipients of the papers turn over with their relief.

The introduction of the classified SIPRNET has triggered explorations of new ways to collect and distribute information, particularly during time-critical real-world operations. CNA analysts in the field during crises in the Persian Gulf and the Balkans were able to collaborate in near-real time with supporting analysts at CNA's headquarters. We sent electronic copies of research documents related to past operations to the fleet via e-mail, allowing the users to receive their information in a matter of hours instead of days or weeks. And we collected and began to analyze operational data with equal speed, helping produce reconstructions and analyses much more rapidly and based on even more timely and accurate information.

CNA researchers can now use a variety of different methods to produce and distribute electronic versions of CNA information products. Once the information is in an electronic format, it becomes far easier to share quickly. Making information more readily available increases the potential for better research and collaboration, both within CNA and between CNA and its sponsors. Electronic formats allow us to correct and update old information quickly and easily. So the information can stay current and valuable to future users, who can now search for and retrieve up-to-date information at any time.

By making our information products available to a larger group of operators and decision-makers, networked access can help more people solve more problems more quickly.

As Dewar argues regarding the broader issue of networked computers in general, "The many-to-many communications medium of networked computers enables the process of preserving, updating and disseminating knowledge to be carried one or two steps further to the immediately available, instant feedback, constantly-updated,

'3-dimensional' (non-fiction) book."¹² Or CNA Research Memorandum.

We are already seeing the Navy and the other military services adopting networked computer communications as their preferred mode of operations in the near future. "Network-centric warfare" is all the rage. More importantly, evidence from recent operations in Iraq and Kosovo argues strongly that networked information flow, work environments, and processes of command, control, and communications are here today. DoN is currently contemplating the award of a contract for a globe-spanning super network, the Navy-Marine Corps Intranet.

How will CNA connect to such an intranet? How can we integrate that connectivity into new ways of working more closely with the commands we support? What implications might that have for how DoN defines its FFRDC relationship with CNA? The potential for CNA and DoN to reshape that relationship and *modus operandi* to make better use of this new environment beckons invitingly.

Indeed, if Dewar is correct in his assessment that the future effects of networked computers on society are likely to be dominated by unintended consequences, then his recommended policy of emphasizing experimentation makes eminent sense. As was the case with the long-term revolution engendered by the printing press, "this is a long-term enterprise with success most likely going to those who have explored the possibilities most thoroughly."¹³ It is past time, then, for CNA and DoN to undertake a serious effort to begin that exploration together.

12. Dewar, 1998.

13. Dewar, 1998.

Games, gaming, gestalts

The power of the network lies in its many-to-many communication capability. There is another tool, somewhat older than the computer network, which shares this capability—games.

Gaming is one of the oldest tools we humans have used to exchange information interactively and in many-to-many fashion. Nearly all of us are at least aware of classical boardgames, like chess, and popular boardgames like Monopoly. And, of course, the military has been using wargames of one type or another as training tools or research devices for nearly two hundred years.¹⁴

In his book *Gaming: The Future's Language*, Richard D. Duke proposes the thesis that “gaming is a powerful new form of communication, particularly suited to conveying gestalt.” Dukes defines this latter term by calling on Webster’s Third New International Dictionary. There, “gestalt” is defined as “A structure or configuration of physical, biological, or psychological phenomena so integrated as to constitute a functional unit with properties not derivable from its parts in summation.”¹⁵

Even 25 years ago, Duke could write that “the problems of today are more complex, involving systems and interacting subsystems that go beyond normal human ken and which do not yield to conventional jargon or traditional forms of communication.” Duke saw gaming as a critically important tool for attacking these problems. He characterized gaming as a “future’s language,” not because he saw it as “the language of the future,” but rather because it would “prove of greatest

14. For a discussion of the history, principles, and practice of wargaming, see Peter P. Perla. *The Art of Wargaming* (Annapolis: U.S. Naval Institute Press, 1990).

15. Richard D. Duke. *Gaming: The Future's Language*. (New York: John Wiley and Sons, 1975) p. xvi.

value in those circumstances where the need to convey gestalt is urgent.”¹⁶ And he characterized the mode of communication that gaming creates as a “multilogue . . . the organized simultaneous inquiry into some complex topic.”¹⁷

One example from our own experience illustrates what Duke might have meant by this.

Following the U.S. strikes on Bosnia which helped bring the contending parties to the Dayton Peace conference, the Navy asked CNA to reconstruct and analyze the events revolving around the use of the Tomahawk Land-Attack Missile (TLAM) in that operation. The analysis drew out the threads of a complex story.

The issues raised by the study were the subject of a series of CNA papers and briefings which increased the awareness of the TLAM community—as well as the NATO and U.S. chains of command—about the issues raised by the Bosnia experience. In particular, the analysis helped foster a broader recognition of some problems with the way the command and control of this system worked in a NATO environment. But this recognition was neither universally held nor identically understood by all important commands. We designed a game based on the results of this study to provide a venue for communicating those results to the key real-world commanders in a dynamic and memorable way. What’s more, the game allowed those commanders to experiment with their own ideas and develop new concepts for the command and control of TLAM in the future NATO environment.

Another way we used gaming to support CNA’s research for the Navy was at the beginning of a study rather than after its end. An example of this was our support for a game examining the use of the military medical community in support of humanitarian assistance operations. By bringing together a cross section of many of the military and civilian participants in humanitarian crises, the study team was able to use the game to explore critical interactions, particularly between the

16. Duke, 1975, p. 44.

17. Duke, 1975, p. 42.

military and civilian medical and relief communities and the operational military forces likely to be charged with overall direction of a mission. Both study participants and expert players from the Navy and other communities responded to a developing scenario and learned much about the problems, issues, and potential solutions for carrying out these sorts of missions in the future.

These uses of gaming to communicate the insights of the past, explore new ideas in the present, and identify new issues for the future are important tools in the analyst's toolbox. In Duke's conclusion, he argued that:

Man has not one future but many futures to choose from, but this choice is predicated on his ability to articulate the various possibilities before they occur. It is beyond human comprehension to deal with the present in a detailed and factual way, and equally impossible to do so for alternative futures. Instead, we need heuristic, overview, or gestalt perception from which we can derive an orientation toward the future that will provide us with crude guidelines for action.

Gaming/simulation is one prospect for assisting us with this task. . . Gaming has particular potential because it permits the individual to approach complex problems from whatever perspective seems germane and to do so in a context which is coherent and logical, and to experiment in an environment which is basically safe.¹⁸

In many ways, Duke was a man ahead of his time. The "Information Age" in which we live today is, if anything, even more complex and interconnected than that of the 1970s. And others have taken up the notion that gaming and simulation (always a popular synonym for those who find the g-word too disturbing) provide us tools we must and will use more in the future. Luis Arata discusses the views of author Sherry Turkle, stating that she "observes that we are starting to move toward a culture of simulation. This is possible, she points out, because people are increasingly comfortable with substituting representations of reality for the real."¹⁹

18. Duke, 1975, p. 171.

19. Arata, 1999, referring to Sherry Turkle, *Life on the Screen: Identity in the Age of the Internet* (New York: Simon & Shuster, 1995), p. 20.

It is perhaps not surprising that the military adapted more readily to this notion of substituting simulations and games as representations for a reality we hope never actually to experience. We have already seen the military's enthusiastic adaptation of networked computers to wargames. SIMNET and its descendants can link vehicle simulators across the country in detailed tactical engagements. And there are those who want to tie this low-level simulation together with command-post-exercise games at the level of a theater commander-in-chief. The technology may well be able to support such a thing as commonplace in the near future.

Thus, the links are strong between gaming and networked computers. Both are many-to-many communications systems. Both are tools to help us interact with and solve complex problems using broader types of collaboration than possible without them. Taking advantage of the network's ability to span the globe, playing games across networked computers can increase the breadth and depth of participation and insight exponentially. Adapting these techniques to games traditionally held in seminar settings, particularly high-level political-military games, is one of the challenges we need to explore more fully in the coming years.

Progress, prospects, and propositions

Over the course of our experimental project, we have developed applications of electronic information products to provide:

- Dynamic media (video and animation) to illustrate and explain dynamic processes
- Multimedia, storytelling, visualization, and information packages
- Electronic presentation packages to allow a briefer to integrate a variety of media into an in-person presentation to communicate results and recommendations more effectively, and with greater ease of access to supporting material
- Electronic reports and repositories of information, integrating text and multimedia material to provide a more comprehensive record and report of project research
- Limited experience with network-based access to information.

In addition to electronic media, our work has explored the use of gaming as an analytical tool and as a medium of communicating the results of analysis. We have used gaming to help improve our (and the Navy's) understanding of critical issues as projects define their problems and develop analytical approaches. We have also used gaming as a powerful means of communicating the results and implications of our analysis. Games can allow operators to develop new insights and explore how those insights might affect the way they operate in the future. Gaming can also shed important light on the technologies, tactics, techniques, procedures, and doctrine that operators may need.

In the process of exploring the new tools and new techniques, we have learned how to create new information products. And we see prospects for more and better such products in the future.

A key development just now getting under way is CNA's involvement with the Navy in creating network-based communities built around common interests in, and needs for, specific types of information. One of these efforts focuses on the Navy's relations with the civilian world. It deals with Navy recruiting—specifically, it is a proposed world-wide-web site dedicated to providing important information to participants in some aspects of the Navy's Delayed Entry Program for enlisted recruits. Another effort, in an even earlier stage of development, is exploring the prospects for CNA to help a Navy warfare community build what we're calling an Electronic War Room. We envision this classified web site as a source of up-to-date information, and a tool for day-to-day collaboration, in the preparation of the community's plan for the future.

These and other prospects for CNA to work with the Navy to produce and distribute new and better information products make this an exciting time. Strengthening the dialogue between us and finding new opportunities to move forward is the order of the day.

To that end, we see three primary directions for CNA to pursue. Some of these ideas require little more from the Navy and Marine Corps than their forbearance. Others may require their support. Still others may need us to form a more active partnership between CNA and DoN, a partnership entirely consistent with, and in the best traditions of, our long-standing relationship as DoN's FFRDC.

Our specific proposals include the following:

- Develop a study to collect and assess existing research into the use of interactive media in the teaching and learning of complex concepts by adult learners, and to propose possible directions for new research to deal with specific issues that may arise in DoN.
- Continue ongoing efforts to expand CNA's ability to produce advanced media and to integrate them into CNA's information products for DoN.

- Begin a CNA-initiated effort to develop guidelines, templates, and basic media tools for use in communicating CNA research more effectively to DoN sponsors.
- Develop a study of recent and projected uses of computer networks in the conduct of military operations and the implications for CNA's ability and requirements to support such operations in the future—using both on-scene analysts and CNA-Washington support. (CNA's recent work on operations in Iraq and the Balkans provides a good jumping-off point for such a study.)
- Begin a CNA-initiated effort to construct basic electronic tools for displaying information and communicating among player cells in political-military seminar games. A possible extension of this effort would explore the development of an on-line gaming environment to allow distributed play of such games, using existing or newly developed tools and techniques.
- Expand CNA's internal education and training program in the use of new media, including the creation of internal web sites to provide information and guidance on the use of such media for specific applications.
- Develop specific projects designed to work with DoN commands to integrate new tools and new channels into the traditional processes and practices of the commands. (CNA's existing project with the Navy Marine Corps Intelligence Training Center on the integration of commercial wargames into its curriculum is an example of such a project.)
- Build on existing and potential efforts to develop web sites for Navy organizations to explore and develop the techniques for creating an interconnected community to allow analysts and operators to share information and collaborate on projects electronically.